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# THE KUROSHIO OFF SOUTHERN JAPAN: ANALYSIS OF DATA FROM THE ASUKA STUDY

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## LONG-TERM GOALS

Determining Kuroshio and Kuroshio Countercurrent transports of volume, heat, and salt off Shikoku, Japan, and their fluctuations on times scales of days to years.

## SCIENTIFIC OBJECTIVES

- (1) Characterising the structure of Kuroshio variability off Shikoku at time scales from 1 day to 1 year.
- (2) Determining Kuroshio volume, heat, and salt transports and their fluctuations at these time scales.
- (3) Developing a simply maintained proxy measurement scheme for Kuroshio volume and heat transports.
- (4) Comparing the Kuroshio in this region with the Kuroshio upstream and downstream—also with the Gulf Stream off the coast of Georgia. Establishing and understanding the similarities and differences.

## APPROACH

For more than two years, we maintained a 1,000 km array of 8 inverted echo sounders (IES) along a TOPEX satellite altimeter line across the Kuroshio off Shikoku Island in southern Japan. Along the same line, Japanese oceanographers maintained an array of current meters (including moored ADCP's) and carried out frequent (more than one a month, on average) hydrographic sections in what was called the “ASUKA” program.

## WORK COMPLETED

We successfully recovered all 8 IES's from the Japanese vessel “T/V Keiten-maru” in November 1995. Despite some data loss in the shallowest instruments, due to acoustic reflections from the bottom, we obtained good data from all instruments. Initial processing and analysis of these IES data records and comparison with TOPEX altimeter data and hydrographic data is completed.

## RESULTS

James and Wimbush (1995) showed that the relationship of acoustic travel time to dynamic height in the Pacific Ocean is especially strong in a broad region centered on the Kuroshio, where there is a tight linear relationship with typical slope of -50 dyn m/s. From 865 ASUKA hydrocasts, we determined that the slope in the ASUKA region (for 0-800 dbar dynamic height) is  $-5.46 \pm 0.12$  dyn cm/ms. This value was used to convert our IES data. By suitably combining the TOPEX altimetry data with our IES data, we were able to separate the barotropic and baroclinic components of the TOPEX-measured sea-surface height signal. The resulting records show baroclinic sea-surface height fluctuations exceeding 75 cm. Maximum barotropic fluctuations were only one-third as large. Pronounced off-shore meanders occurred three times a year, in February, June, and October in both years. These are meanders of up to 50–150 km, lasting 2 weeks to 2 months.

The Japanese current-meter data set will soon be available. By incorporating it with the IES measurements we should be able to determine the time-varying baroclinic and barotropic transports.

## IMPACT/APPLICATION

Although the Kuroshio is comparable to the Gulf Stream in its importance to heat and momentum transfers in the ocean, our knowledge of the Kuroshio is much less than that of the Gulf Stream. This project is intended to expand significantly our knowledge and understanding of the Kuroshio.

## TRANSITIONS

The work was done as part of a coordinated program named “ASUKA” (Affiliated SURveys of the Kuroshio off Ashizuri-misaki) involving Japanese oceanographers from Kyushu, Kagoshima, Tokai, Hiroshima, Tokyo, and Mie Universities, and from the Japan Hydrographic Office (Maritime Safety Agency), the Japan Meteorological Agency, and the Japan Fisheries Agency.

## RELATED PROJECTS

The first 7 months of the ASUKA deployment period corresponded to the last 7 months of the 22-month deployment period of the KERE array, situated nearly 1,000 km downstream.

## REFERENCES

James, C.E., and M. Wimbush, 1995: Inferring dynamic height variations from acoustic travel time in the Pacific Ocean. *Journal of Oceanography*, 51, 553–569.